Injection and Acceleration of High Charge State Iron in Booster

C.J. Gardner

April 25, 2002

1. 35–40 μA Fe^{20+} was transported to TTB beamstop. A 3 μg terminal foil and a 30 μg object foil were used. The reading of the NMR probe in the first 90° bend of the TTB line was 4364.69 G for the transport of this charge state. (This is to be compared with a reading of 7958.07 G for the transport of Fe^{10+}).

2. 15–20 μA Fe^{21+} was injected into Booster and accelerated to approximately 850 MeV per nucleon. Figures 1 and 2 show oscilliscope traces of the injection and acceleration. Approximately 8×10^8 ions were captured and 4×10^8 were accelerated to full energy. (Our intent was to inject and accelerate Fe^{20+}, but Fe^{21+} is what was transported down the TTB line. This happened because the field in the first 90° bend got set to the wrong value—it was set to 4348.9 G by mistake.)

3. Capture and acceleration were carried out with RF harmonic $h = 4$. (We had planned on using $h = 3$, but the hardware was not set up for this.) $hf = 5.0686$ MHz was measured at top energy.

4. Initially, a stopband loss occured not far from the top energy. This was eliminated by raising the tunes.

5. Booster dipole field was ramped to 10 kG (4115 A) as shown in Figure 3. The parameters of the magnetic cycle are listed in Table 1. The 3.2 second cycle ran for several hours without any problems.

6. Figure 4 shows regions of Booster tune space accessible for various magnetic rigidities assuming currents of ±1000 A in the tune quadrupole strings. The rigidity at 10 kG is 13.8656 Tm.

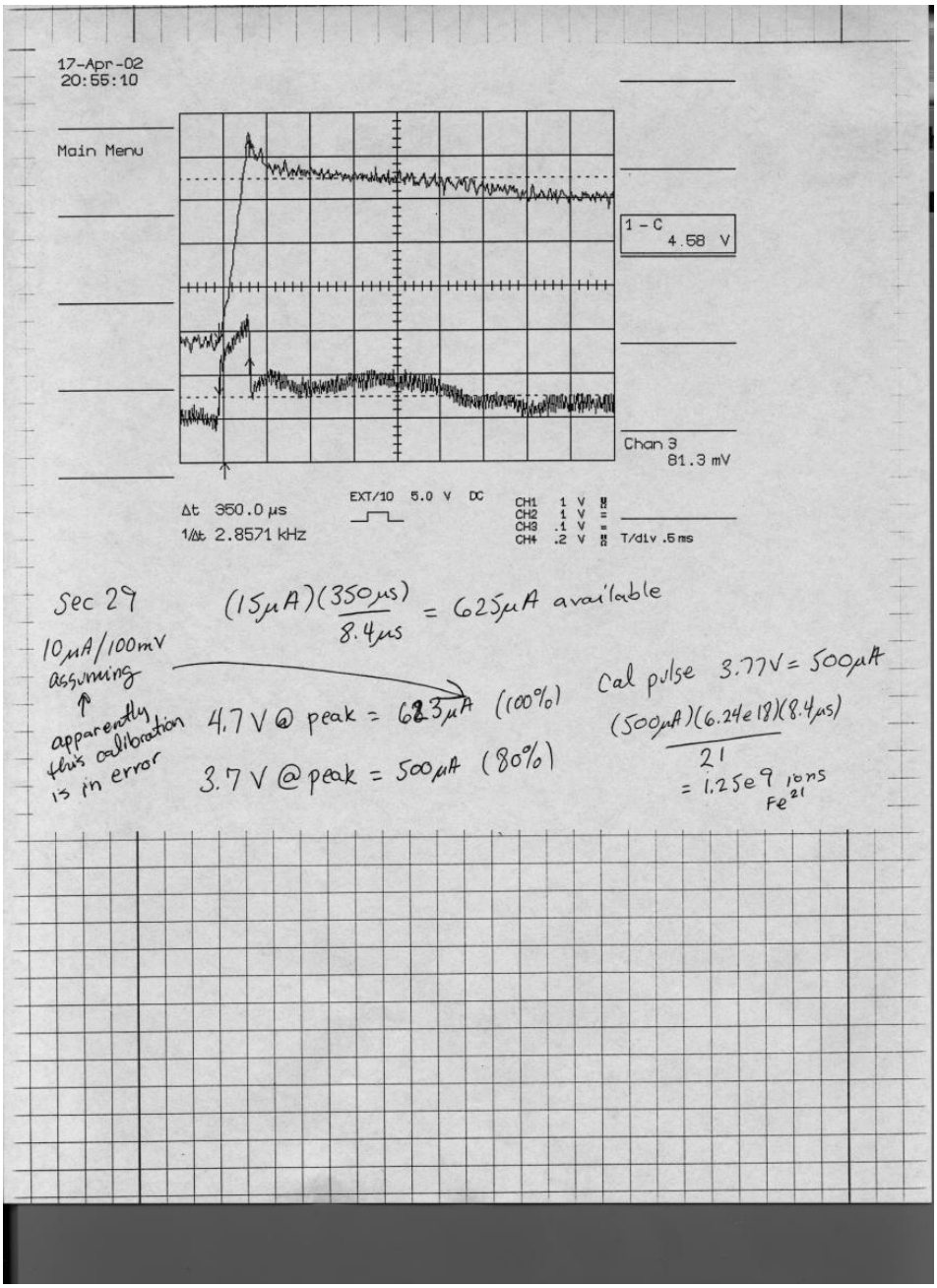

Figure 1: Fe^{21+} Injection

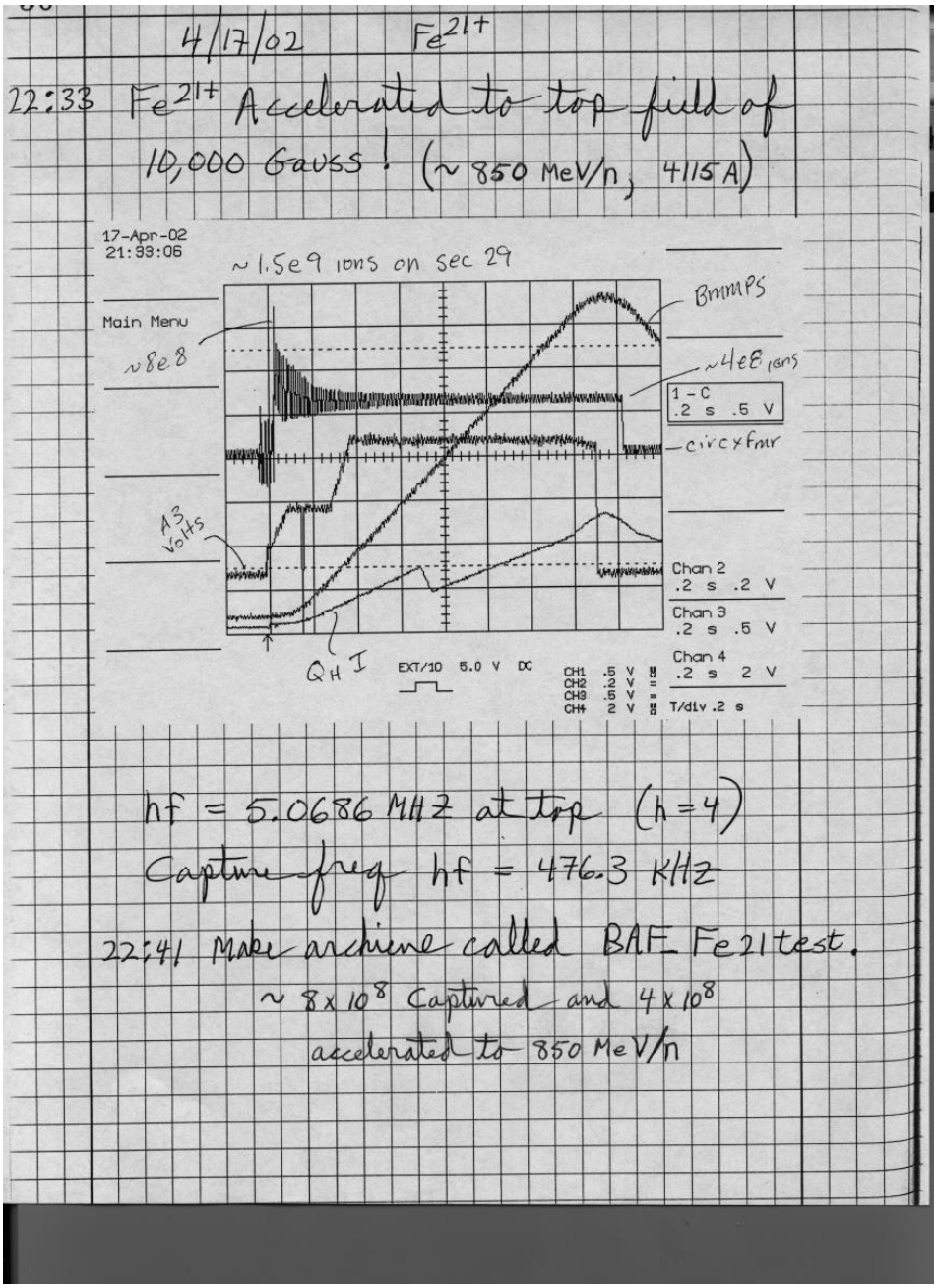

Figure 2: Fe^{21+} Capture and Acceleration

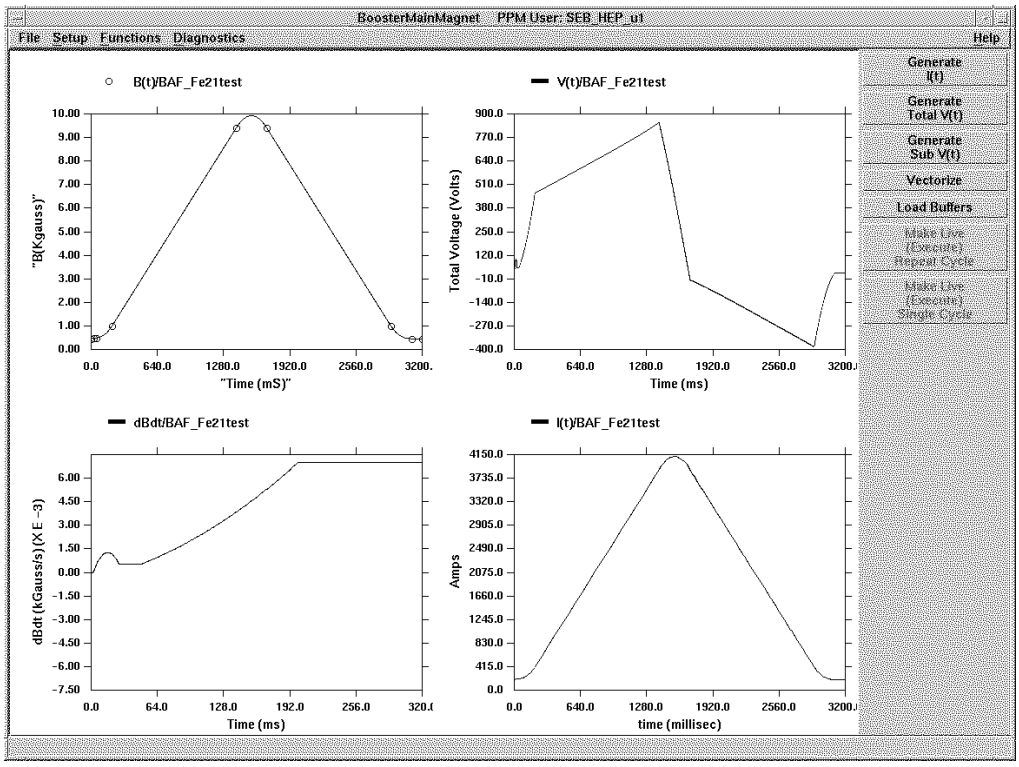

Figure 3: Booster Main Magnet Functions

Table 1: Function Parameters. **Boldface** numbers indicate defined slopes. All other slopes are derived.

t(ms)	B(kG)	Connection	m_1	m_2
0	0.460	Linear	0	0
2	0.460	Linear	0	0
27	0.483	Cubic	0	**0.0005**
47	0.493	Linear	0.0005	0.0005
200	1.000	Cubic	**0.0005**	**0.007**
1400	9.400	Linear	0.007	0.007
1700	9.400	Cubic	0.007	**−0.007**
2900	1.000	Linear	−0.007	−0.007
3100	0.460	Cubic	−0.007	**0.0**
3200	0.460	Linear	0	0

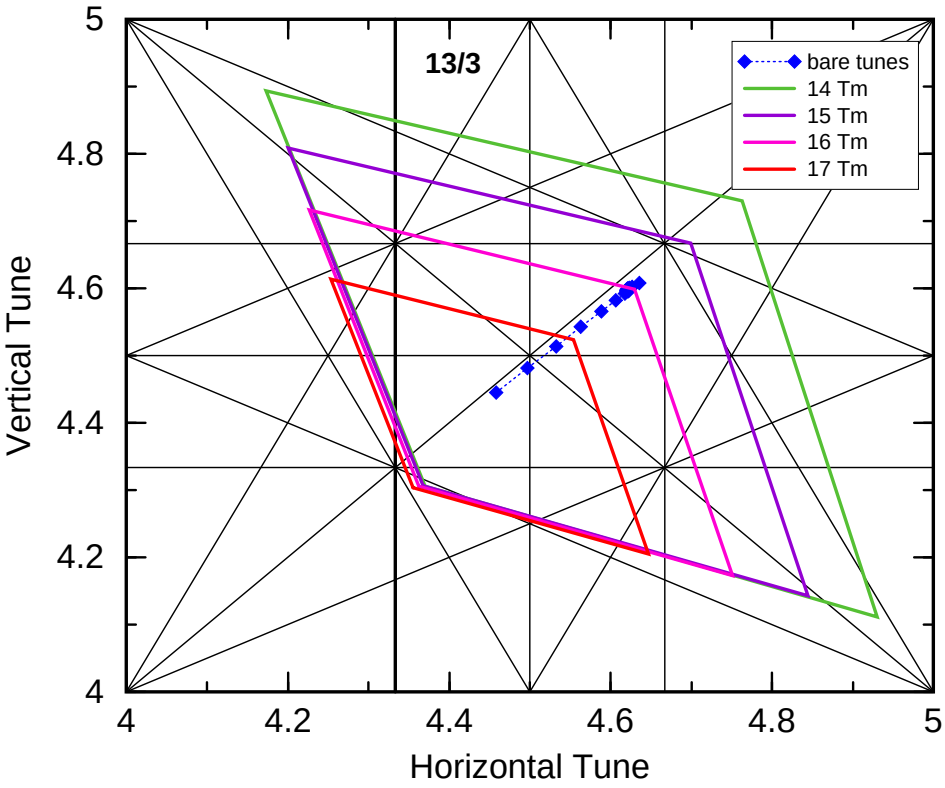

Figure 4: Booster Tune Control at High Field